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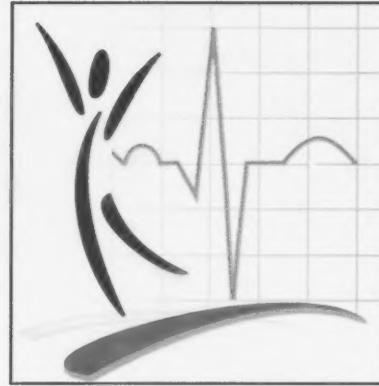
Health at a Glance

Ninety years of change in life expectancy

by Yves Decady and Lawson Greenberg

Health Statistics Division

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0*	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the <i>Statistics Act</i>
E	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Health *at a Glance*

Ninety years of change in life expectancy

by Yves Decady and Lawson Greenberg

Highlights

- In 2011, Canadians lived an average of 81.7 years. This is an increase of 24.6 years since 1921.
- Nearly half of all the gains in life expectancy occurred in the period between 1921 and 1951, largely due to reduced infant mortality.
- Reduced deaths from circulatory diseases account for most increases in life expectancy since 1951.

It is common to read articles reporting that people in developed countries are living longer, and that more Canadians are reaching 90 or even 100 years of age.¹ In fact, centenarians were the second fastest growing age group according to the 2011 Census results.²

Life expectancy is an estimate of the average number of remaining years of life at birth or other ages, based on death rates calculated for a given period. Because it is an average, some people will live longer and some will not reach the estimated life expectancy. Also, a person can live longer than their life expectancy if they benefit from future developments that extend life.

Historically, life expectancy has been lower for men than women. Although the gap between the sexes was small in 1921 (1.8 years), it reached a high of 7.4 years in 1975–1977 and narrowed to 4.3 years in 2010–2012.³ Also, during

part of this period—from 1920–1922 to 1980–1982, life expectancy at age 1 has been higher than life expectancy at birth, mostly as a result of high infant mortality.⁴

In 2011,⁵ life expectancy at birth in Canada was 81.7 years. From 1921 to 2011, life expectancy at birth increased from 57.1 to 81.7, a gain of 24.6 years.

While a gain of 24.6 years overall may seem dramatic, life expectancy shows smaller gains over the same time period when calculated for older age groups. For example, in 1921, life expectancy at age 55 was 20 years. In other words, the average 55-year-old could expect to live to age 75. Today, a 55-year-old can expect to live an additional 29 years (to age 84), a gain of nine years over the past 90 years.

A similar result can be seen for 90-year-olds. In 1921, life expectancy at age 90 was 3.4 years. By 2011, a 90-year-old could expect to live another 5.3 years, a gain of 1.9 years during the 90 year reference period (Chart 1).

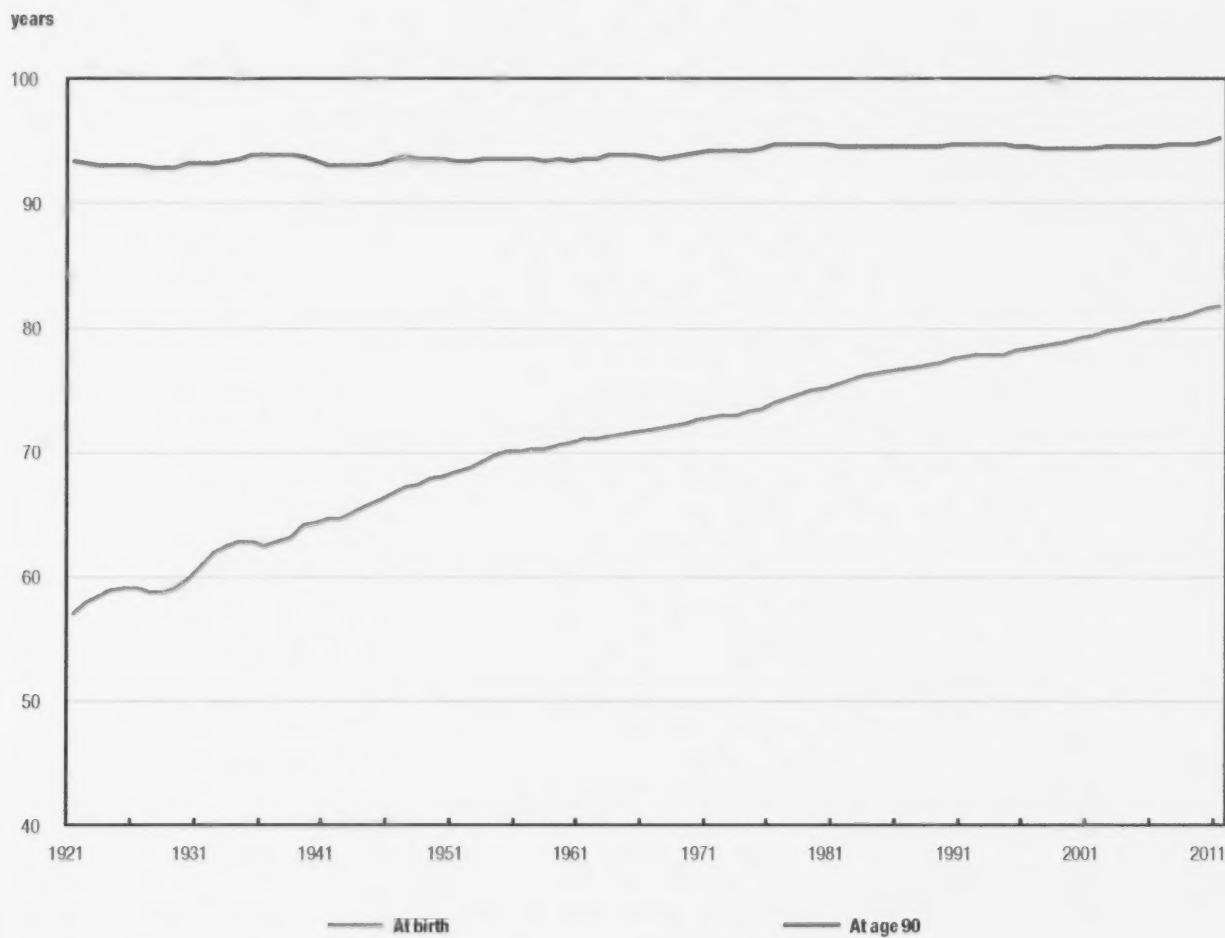
The above analysis raises a frequently asked question: if life expectancy at birth in 1921 was 57.1 years, how is it that in the same year a 55-year-old could expect to live another 20 years, or a 90-year-old another 3.4 years?

There are at least two reasons for this result. First, life expectancy is calculated as an average that takes into account deaths at all ages in the population. This reflects the fact that some people live longer and some do not

reach the estimated life expectancy. Second, calculating life expectancy at a given age requires survival to that age as earlier risks of death are overcome.

This article explores the patterns and frequency of death by age and by cause in the population. The main goal is to explain how and why life expectancy has changed over a 90-year period.⁶ Although the article is primarily focused on mortality, it concludes with a brief discussion about how living longer may be associated with deteriorating health in later years of life. The main sources of data are the **Canadian Vital Statistics Death Database** and the **Canadian Mortality Database**.

Chart 1
Total number of expected years of life at birth and at age 90, 1921-2011



Note: The total number of expected years of life is computed as attained age + life expectancy at that age.

Source: Statistics Canada, Canadian Mortality Database, Canadian Vital Statistics-Deaths.

The Canadian Vital Statistics - Death Database (CVS: D) collects demographic and cause of death information annually from all provincial and territorial vital statistics registries on all deaths in Canada. Causes of death data in this database go back to 1926. In order to help with usage, data have been standardized as of 1974.⁷

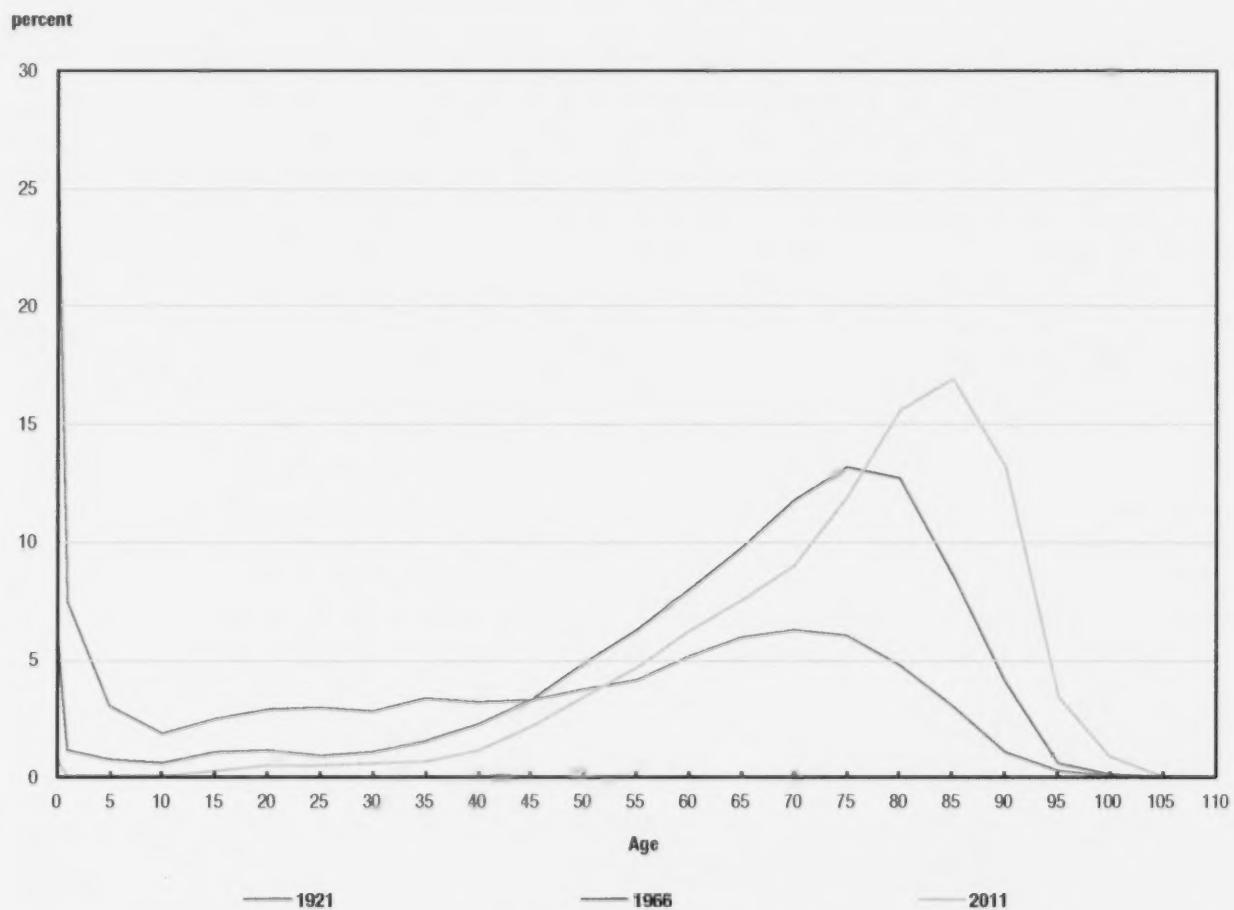
The Canadian Mortality Database (CMDB) is based on the Canadian Vital Statistics Death Database (CVS: D). The CMDB may contain death records and information updates made after the official publication of the vital statistics. Causes of death data in this database go back to 1950.⁸

Patterns in mortality by age

One way to better understand changes in life expectancy over time is to explore the pattern of the age at death in the population. Chart 2 depicts this by comparing the percentage of deaths by age, for three different time points: 1921, 2011 and the mid-point, 1966.

By examining Chart 2, several important observations can be made. First, in 1921 the highest proportion of deaths occurred during the first year of life. This contrasts sharply with the much lower proportion of infant deaths in 1966 and in 2011.

Chart 2
Percentage of deaths by age, Canada, 1921, 1966 and 2011



Source: Statistics Canada, Canadian Mortality Database, Canadian Vital Statistics-Deaths.

Second, in 1921 most deaths occurred over a wide range of years (55 to 79) compared to deaths in 2011 that were more concentrated in a narrower range of ages (75 to 89). This was due to an increase in deaths among older age groups, and fewer deaths among younger age groups. Also, the most common age at death in 1921 (excluding infant deaths) was 70, and by 2011 it was 85, an increase of 15 years. Lastly, the peaks of the distributions in Chart 2 become steeper and steeper over time, suggesting that survival to older ages may be approaching a natural limit.⁹

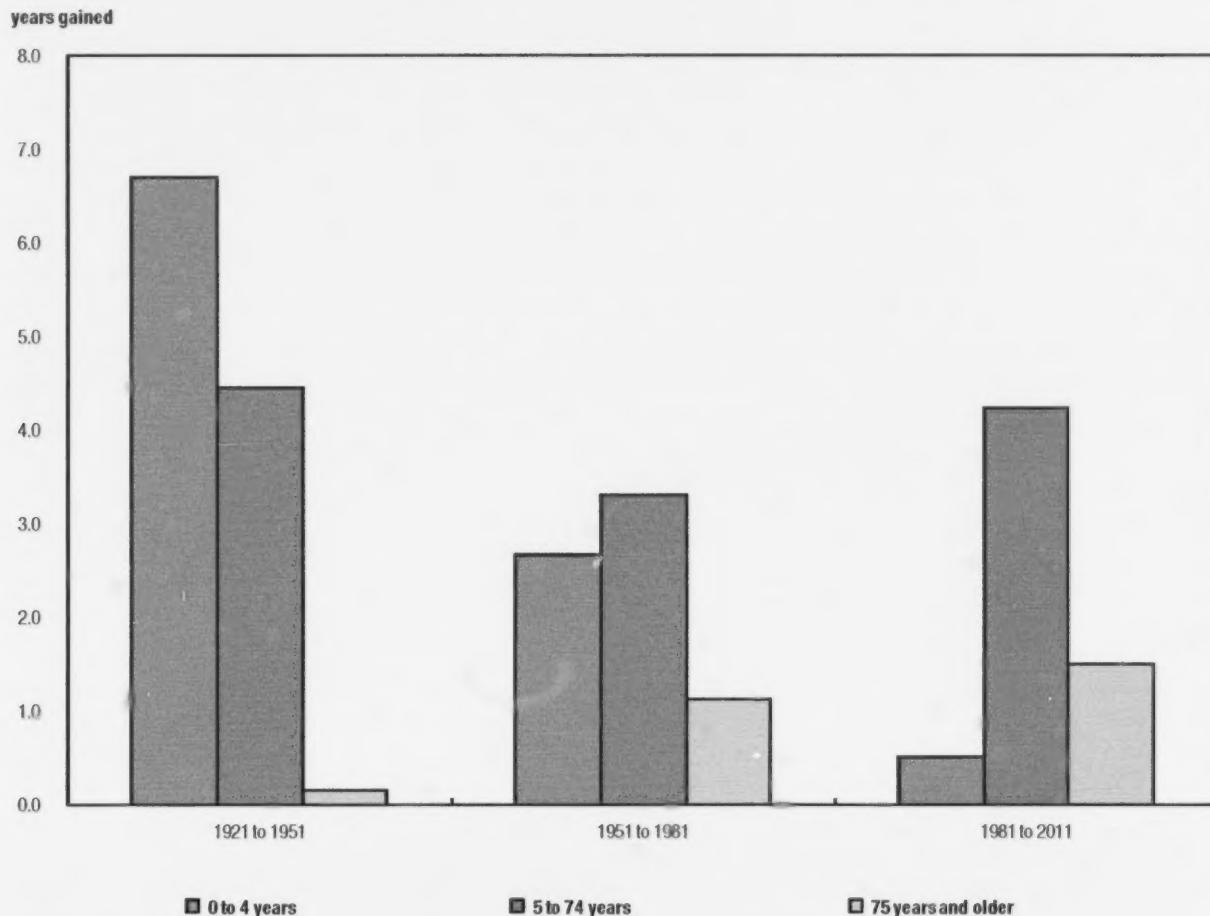
Changes in life expectancy by age

Dividing the past 90 years into 30-year periods shows that the gains in life expectancy for the entire population are slowing down (Chart 3). The largest gain in life expectancy at birth (11.3 years) was between 1921 and 1951. This compares with a gain of 7.1 years between 1951 and 1981, and of 6.2 years between 1981 and 2011.

Most of the increases in life expectancy in the past 90 years came from declines in what is frequently called premature death, that is to say death among individuals who are younger than age 75.

Looking at gains by age group within each period (Chart 3) shows that declines in infant and child deaths between 1921

Chart 3
Years gained in life expectancy at birth for selected age groups, Canada, 1921-1951, 1951-1981, and 1981-2011



Source: Statistics Canada, Canadian Mortality Database, Canadian Vital Statistics-Deaths.

and 1951 contributed the most to the increase in life expectancy at birth.¹⁰ That is, during the 1921 to 1951 time period, out of the 11.3 years gained, 6.7 were the result of improvements in infant (under 1 year of age) and child (ages 1 to 4) mortality rates. From 1951 to 1981, further declines in infant and child mortality accounted for 2.7 years out of the 7.1 years gain. During the last period (1981 to 2011), this contribution was 0.5 years (6 months) out of the 6.2 additional years.

The second largest contribution to increased life expectancy was the reduction in deaths in the 5 to 74 age group (Chart 3). Between 1921 and 1951, declines in deaths occurring in the 5 to 74 age range contributed to the remaining gains in life expectancy, that is, 4.5 out of 11.3 years. From 1951 to 1981, declines in deaths among the 5 to 74 age group contributed to about half of the gain in life expectancy, and in the last period (1981 to 2011) to the majority (two-thirds) of the gain (4.2 years out of 6.2).

From 1921 to 1950, several major advances in public health took place. Two noteworthy examples are childhood immunization against infectious diseases, and life-altering scientific discoveries such as penicillin and insulin.¹¹ Other major developments with significant impacts on the population health for the remainder of the century and up to the present time included new approaches in health promotion, illness prevention, community advocacy and the use of legislation along with the introduction of broad social programs.¹²

Over the past 90 years, life expectancy has not greatly increased for those over 75 years of age.

Changes in life expectancy by causes of death

Exploring changes in the main causes of death over the past 60 years helps further explain the changes in life expectancy.¹³ Reductions in deaths from circulatory system diseases, such as heart disease, were the biggest contributors to gains in life expectancy (Chart 4).

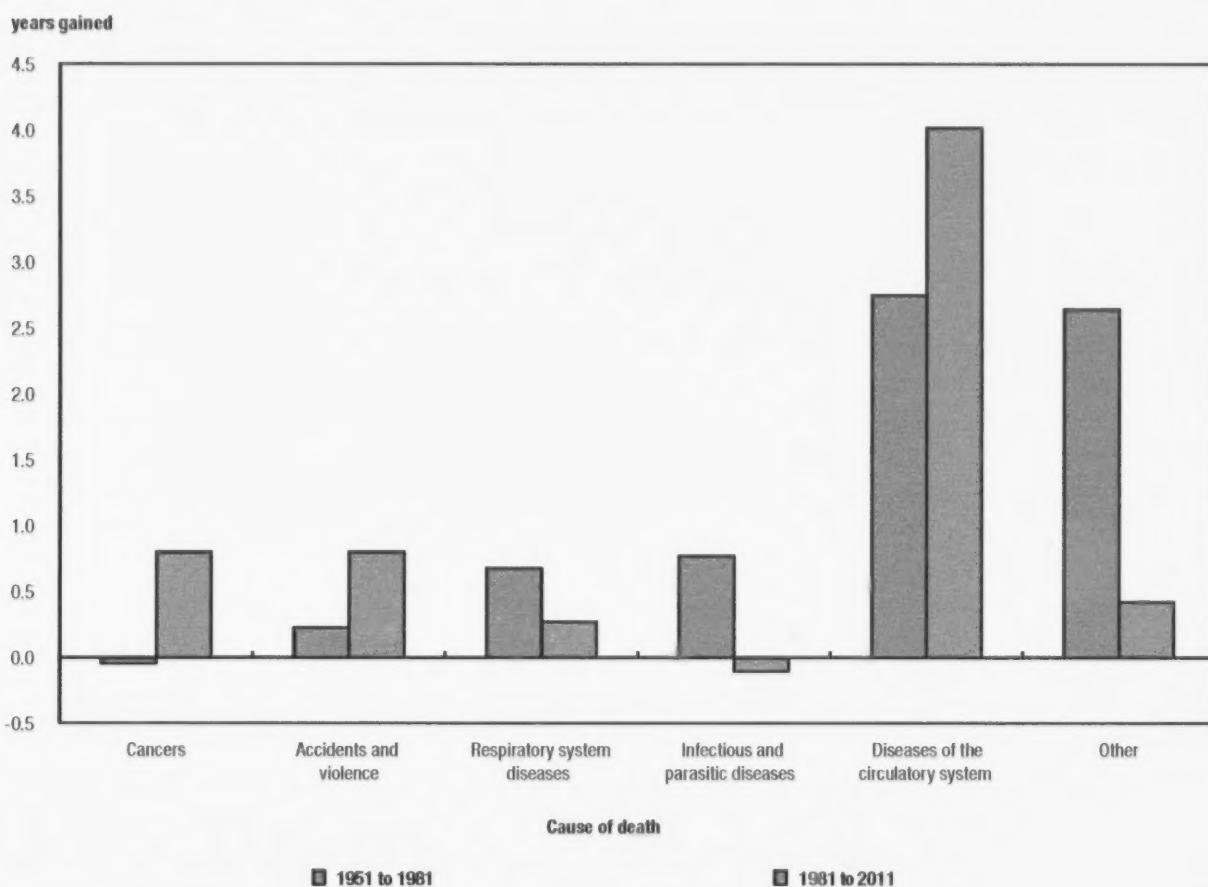
From 1951 to 1981, declines in deaths from infectious and parasitic diseases, and respiratory system diseases were the next biggest contributors to years gained in life expectancy, while cancer survival did not play a part in improvements in life expectancy. However, from 1981 to 2011, longer cancer survival contributed to a gain of 0.8 years (about 10 months) to the life expectancy of the population.

Gains in life expectancy also occurred because there was a reduction in deaths caused by accidents and violence from 1981 to 2011, contributing a gain of 0.8 years (compared to 0.2 years in the previous 1951 to 1981 period). The reduction in accidents was fostered by various health awareness campaigns and legislation to prevent injury such as making seat belt use mandatory, which contributed to decreased traffic deaths.¹⁴

A slight increase in deaths due to infectious and parasitic diseases between 1981 and 2011 contributed to a decrease of 0.1 years (about a month) in life expectancy. Infectious diseases remain a challenge with the resurgence of previously controlled diseases and the introduction of new infections.¹⁵

Chart 4

Years gained in life expectancy at birth resulting from declines in deaths from selected causes of deaths, Canada, 1951-1981 and 1981-2001



Source: Statistics Canada, Canadian Mortality Database, Canadian Vital Statistics-Deaths.

Living longer and quality of life

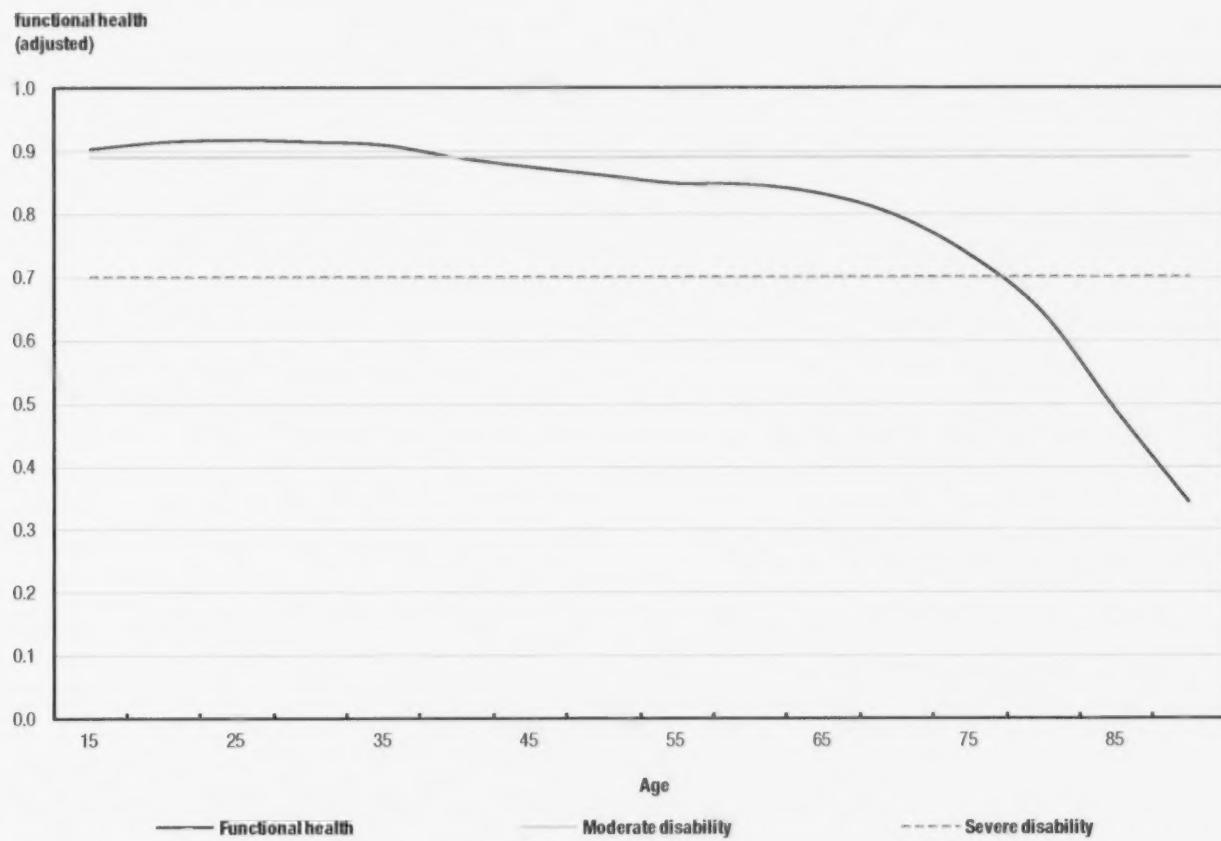
Although Canadians are living longer, with a life expectancy of 81.7 years and a most common age at death of 85 years, the ability of many adults to perform key health functions, that is, their functional health¹⁶ declines as they age. The increasing proportion of Canadians reaching older ages raises issues about demand for health services and delivery of care.

Chart 5 shows that after age 65, the decline in the functional health line tends to accelerate, with more severe disability (many activity limitations) occurring, on average, around age 77.

A person's **functional health** is measured using a scoring system based on self-reported performance on eight key health attributes: vision, hearing, speech, mobility, dexterity, feelings, cognition and pain. This scoring system, the Health Utility Index Mark 3 (HUI3), was developed at McMaster University.¹⁷ This score can be used to categorize people as having varying degrees of disability on a scale from 0 to 1, where lower numbers mean greater disability. The article focuses on moderate or severe disability:

Moderate disability occurs when a person is prevented from performing *some* activities due to limitations in their ability to function in at least one of these eight health attributes (vision, hearing, speech, mobility, dexterity, feelings, cognition and pain), and the limitation cannot be corrected (a functional health score between 0.7 to 0.9).

Chart 5
Functional health of Canadians, 2009-2010



Source: Statistics Canada, Canadian Community Health Survey, National Population Survey, 2006 Census, Canadian Vital Statistics-Deaths

Severe disability occurs when a person is prevented from performing *many* activities due to limitations in their ability to function in at least one of these eight health attributes (vision, hearing, speech, mobility, dexterity, feelings, cognition and pain), and the limitation cannot be corrected (a functional health score of less than 0.7).

Another way to look at the quality of life during the later years of life is to calculate the equivalent number of years a person can be expected to live in good (or "full") health.¹⁸ This measure has been qualified as health-adjusted life expectancy (HALE). The latest estimate of health-adjusted life expectancy at birth is 69 years for men and 71 for women.¹⁹ That means that the average Canadian can expect to live roughly 10.5 years with some level of disability.

In this context, the challenge for an aging population will be to seek ways to prolong the healthy life years.

Yves Decady and Lawson Greenberg are analysts with the Health Statistics Division.

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Notes

1. See Wister 2007.
2. See Statistics Canada 2012.
3. See Nault 1997.
4. See Greenberg 2011.
5. The life expectancy estimate for the 2010-2012 period used the Vital Statistics - Death Database for 2010 and 2011 and population and deaths estimates for 2012.
6. See Arriaga 1984.
7. See Statistics Canada. Vital Statistics - Death Database 2013.
8. See Statistics Canada. Vital Statistics - Death Database 2013.
9. See Kannisto 2001.
10. See Arriaga 1984.
11. See Public Health Agency of Canada 2008.
12. See Public Health Agency of Canada 2008.
13. See Preston 2001.
14. See Public Health Agency of Canada 2008.

15. See Public Health Agency of Canada 2008.
16. The functional health scores in Chart 5 were calculated by combining the average Health Utility Indexes (HUI) from the Canadian Community Health Survey, and the average HUI from the National Population Health Survey (NPHS) institutional component, according to the proportion of the population.
17. See Feng 2009.
18. See Wolfson 1996.
19. See CANSIM table 102-0122.

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